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13. ABSTRACT ***(Maximum 200 Words)***

The tunable ultrafast laser system with femtosecond and picosecond pulse capability and 1 kHz repetition rate has been purchased and installed. Equipment was acquired for ultrafast and photo-gated hole-burning studies of materials for frequency and time domain spectral hole burning (SHB) optical storage. The goal is directed towards more efficient novel materials for SHB optical storage and photonics devices. Initially, the instrument has been used for measurements of the fluorescence decay time for several free-based and metallo-naphthalocyanines at temperatures 300 K and 8.5 K.

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(DURIP 99) Instrument for Ultrafast and Photogated Spectroscopy

of Materials for Hole Burning Optical Storage

Air Force Office of Scientific Research

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Equipment was acquired for ultrafast and photo-gated hole-burning studies of materials for frequency and time domain spectral hole burning (SHB) optical storage. The goal is directed towards more efficient novel materials for low and high temperature operation of SHB optical storage and photonics devices. The state of the art tunable ultrafast laser system with femtosecond and picosecond pulse capability and 1 kHz repetition rate has been purchased and installed.

The following items were purchased from Spectra-Physics:

1. Millennia-Vs-P – Ultra-compact high power diode pumped solid state laser producing >5 W of CW output power at 532 nm.
2. Model 3941-M1S-USP – Regeneratively mode-locked Ti: Sapphire laser in ultra-short-pulse configuration with sub 50 fs pulse width. Requires Millennia as pump source.
3. Merlin-1-5 kHz Nd:YLF intra-cavity doubled pump laser for use with the Spitfire amplifier.
4. Spitfire-LPM-UPG – Upgrade kit for long picosecond (>2-10 ps) operation.
5. SSP – Option for single shot autocorrelator for ps measurement.
6. Model 407A-1 High power optical power meter system.
7. Spectrum Diagnostic – Tsunami diagnostics package for continuous monitoring of output wavelength and spectrum.
8. OPA-800CFP – Compact femtosecond and picosecond optical parametric amplifier for the Spitfire with tuning from 1.1 μm to 3.0 μm.
9. Model SSA-F – Single shot autocorrelator for fs measurement.
10. Spitfire-USFPM-1K – 1 kHz Tunable Ti: Sapphire regenerative amplifier with spectral mask for use with fs oscillator.

Prior to the purchase of this equipment, we have evaluated three laser systems from the leading manufactures of the most advanced ultrafast lasers, Clark-MRX, Coherent/Quantronix, and Spectra-Physics. We have selected the Spectra-Physics system for better performance and flexibility suitable to our research. This system is tunable in the optical communication wavelength region 1μm – 3μm, as compared to the originally proposed system from Coherent. Items 1 to 9 were purchased using the combination of budgets of the actual grant ($190,000) and the other AFOSR funded grant ($26,725). Item 10 was purchased using CUNY matching funds ($68.275).

Initially, the instrument has been used for the measurement of the fluorescence decay times of several free-based and metallo- naphthalocyanines at temperatures 300 K and 8.5 K. The experimental setup is shown in Fig. 1. To excite fluorescence, laser pulses with the length of 2 ps and wavelength 400 nm were used. Fluorescence was detected using a ultrafast photodiode and 500 MHz digital oscilloscope. Time resolution of this detection system was better than 1 ns. A typical decay curve is presented in Fig. 2 for 100 cycles of data acquisition. For system 2,11,20,29-tetra-tert-butyl-2,3-naphthalocyanine in polyvinyl butyral at 8.5 K, the decay time was found to be 3.94 ns.

The instrument will be used for the characterization of prospective materials for multi-color SHB storage inaccessible with available laser sources; in particular, for the investigation of the materials for ultrafast data readout and single shot data writing capabilities for advanced Terabits capacity optical storage and Terabits/sec rate communication devices. Also, this instrumentation will be used for studies of multiphoton gated persistent hole-burning in prospective organic and metaloorganic materials where intermediate states involve excited Stark or vibrational levels with short lifetime in the range of 10^{-11} - 10^{-12} sec.

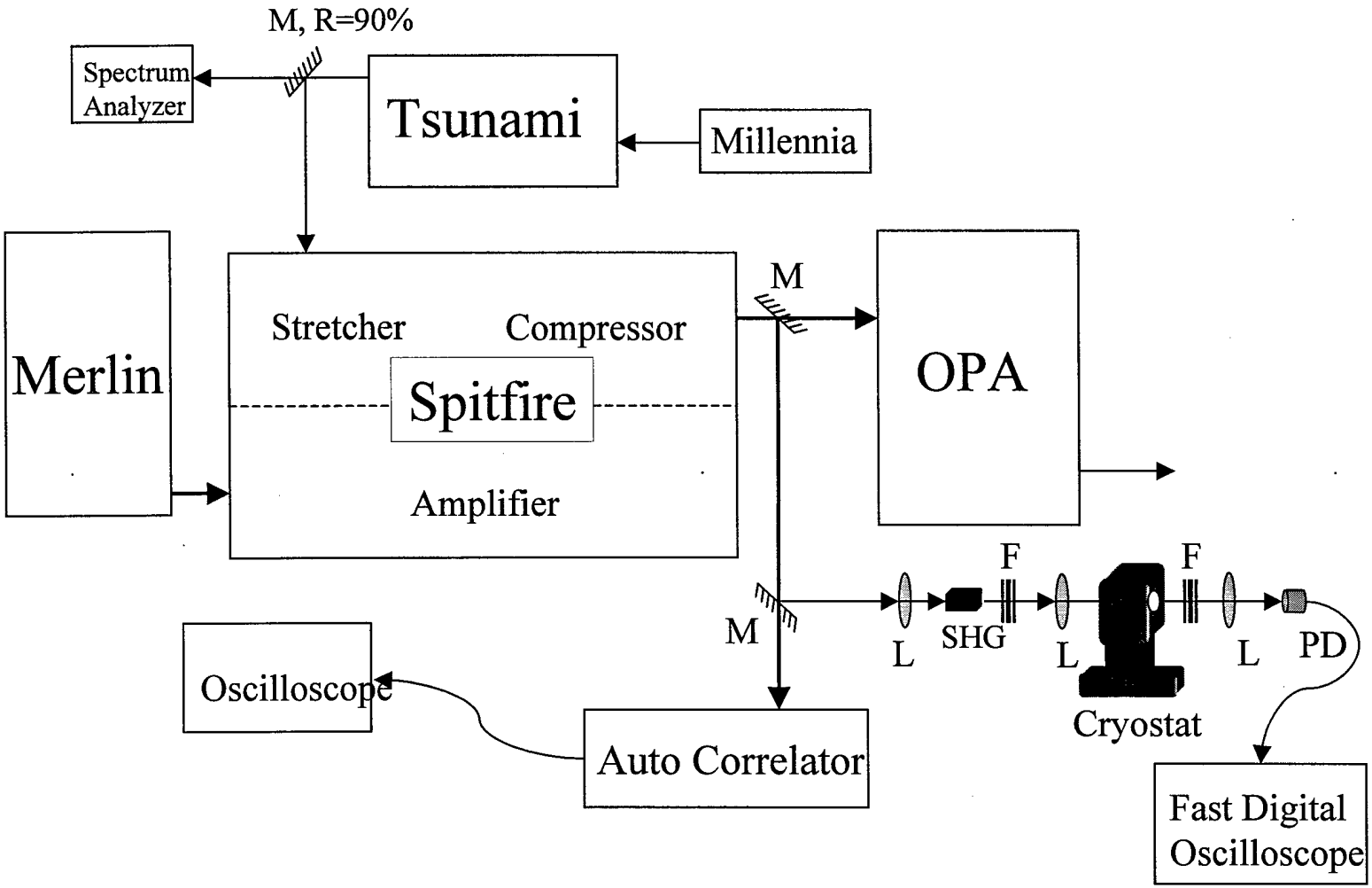

Fig 1. Experimental setup for measurements of optical lifetime
M: Mirror, L:Lens, F:Color Filter, PD:Photodiode

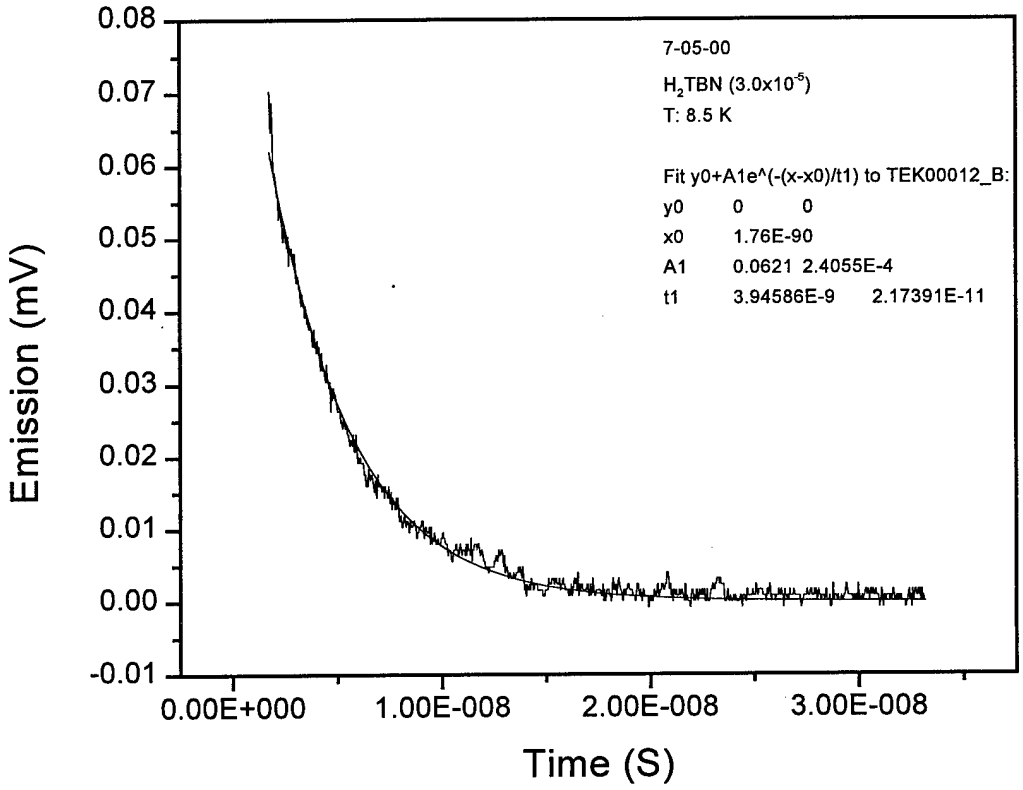

Fig. 2. Fluorescence decay of H_2TBN at 8.5 K, under 2 pS pulse excitation at 400 nm, 1mW/cm^2.